EXPERT SYSTEMS-NEW MODELLING TECHNIQUE IN TRANSPORTATION.

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1. Introduction

Decision problems are commonly divided into three types: structured, unstructured and semi-structured [3]. Structured are those for which solution procedures are known and can be implemented. Unstructured problems do not have known solution methods. In this case a decision maker is left to rely mainly on his own knowledge, on intuition and subjective judgment. A semi-structured decision problem is one that can be analyzed into subproblems, some of which are structured. The concept of decision support system /DSS/ is that of an interactive computer program, which can be used by a decision maker or analyst to partition the decision problem into structured and unstructured elements. DSS have emphasized analyst or user-directed interactive sensitivity analysis /what -if analysis/. This general concept is well established and accepted.
In parallel with the development of DSS concepts and practices, researches in artificial intelligence /AI/ have sought to design ways to capture the knowledge and intuitive judgments of individuals with valuable expertise. These investigations have led to the concept of an expert system /ES/. DSS is a more geral concept, subsuming expert systems,which are new and very interisting modelling technique.

2. Expert systems - modelling technique.

These techniques are applicable to problems requiring specialized knowledge and experience in judgment for determination of solution strategies. This is why semi-structured and unstructured decision problems can be supported by expert systems.
These systems hold enormous potential to become useful tools for transportation practitioners [see 4,5,7]. The potential applications of ES in transportation are discussed in details by Yeh and others [7].
The major stages of an expert system development are following [see 6 p. 24]:
identification: determining problem characteristices;
conceptualization: finding concepts to represent knowledge;
formalization: designing structures to organize knowledge;
implementation: formulating rules that embody knowledge;
testing: validating rules that embody knowledge;

3. Expert systems shells.

The professional development approach-using only Lisp-based machines and knowledge enginerrs-is very expensive and complicated. Thus its use in majority of enteprises is not justified.
Lately, expert system companies have been created package, called expert systems shells /ESS/. They are appropriate for developing rule-based systems, using PC /640 kbytes memory/. ESS, e.g. EXSYS, Insight 2+, ESP-Advisor, Guru, simplify the job of creating rule-based system. Some of ESS are able to process up to 5,000 rules on PC computer. They provide a program called "inference engine", the explanation subsystem and the human interface. The inference engine manipulates and examines knowledge base /Kb/, as diagrammed in figure 1. The key idea is to separate Kb as much as possible from inference engine. Only Kb has to be created. The creation of Kb requires learning how to present knowledge according to IF-THEN rules /figure 2/. Thus shells seem to be appropriate tools for nontechnical users.

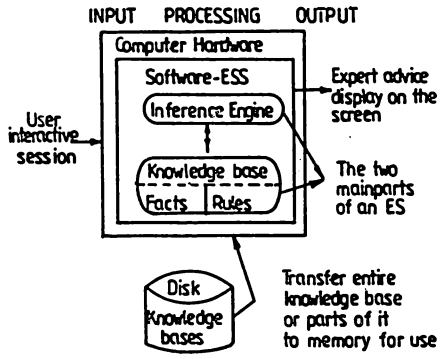

Figure 1. A skeletal ESS

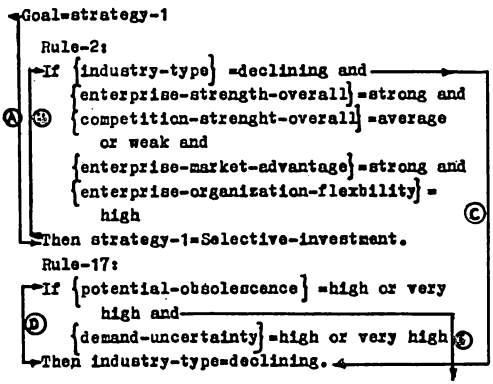

Figure 2. Typical rules in ESS

Finding an appropriate ESS is not a problem [see 1,2] . It is well accepted that development of ES is an incremental process. To develop ES I recommende to start with small rule-based system /30 to 50/, using PC-based ESS. That does not mean it is trivial problem. Expanding and changing this Kb is easy. Rules are easily added to, changed, deleted. This features distinguishes ESS from conventional computer systems. The development and maintenance phase are separated in conventional systems. Translation Kb from the old to the new ESS is easy. In my experience with ES, based on my work using systems: ESP-Advisor and Personal Consultant Plus, the quick translation process depends on careful planning and structured design of old system.

4. Summary

ESS have many limitations. They are not robust enough for very large industrial use. Majority of ESS has not a spreadsheet capability. They cannot use effectively existing data base constructed with conventional data base technology. However, a new promissing ESS, called Guru, /Micro Data Base Systems, Inc.,/ integrates expert system capabilites with such function like: spreadsheet, database management, word processing, graphics and communications.
These features are very important for economic applications in transportation enterprisis.
It is expected that ES are not able to replace experts but can support them efficiently.

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